

CLAIMS

What is claimed is:

1. A method for generating code and simulation information for use by a controller and a simulator, respectively, the method comprising the steps of:
 - for at least one mechanical resource, encapsulating resource logic in a control assembly (CA);
 - 5 identifying at least one of the CAs corresponding to at least one resource;
 - using the at least one identified CA instance to generate code for controlling the at least one resource; and
 - using the at least one identified CA instance to generate simulation information.
2. The method of claim 1 further including the step of providing the code and the simulation information to the controller and the simulator, respectively.
3. The apparatus of claim 2 further including the steps of using the controller to perform the code thereby generating output signals, providing the output signals to the simulator and using the simulator to generate simulator output as a function of both the received output signals and the simulation information.
4. The method of claim 3 wherein the simulator output includes at least one of feedback signals to the controller and visual representations of at least one resource cycling through activities.
5. The method of claim 1 wherein the step of identifying at least one CA corresponding to at least one resource includes providing an interface for specifying the at least one resource.
6. The method of claim 5 wherein the step of providing an interface includes providing a graphical user interface wherein icons are used to graphically represent the at least one resource.

7. The method of claim 6 further including the step of using the interface to specify specific characteristics of at least a sub-set of the resources associated with the at least one identified CA.

8. The method of claim 1 wherein the step of using the at least one identified CA to generate code includes compiling the logic in the at least one identified CA to generate the code.

9. The method of claim 8 wherein the step of using the at least one identified CA to generate simulation information includes gleaning information from the at least one identified CA and using the gleaned information to generate the simulation information.

10. The method of claim 1 wherein the step of using the at least one identified CA to generate simulation information includes gleaning information from the at least one CA and using the gleaned information to generate the simulation information.

11. The method of claim 10 wherein the step of encapsulating also includes encapsulating simulation information for the at least one resource corresponding to at least one CA and wherein the step of gleaning includes retrieving the simulation information.

12. The method of claim 11 wherein the controller is a programmable logic controller that provides I/O combination output signals, the simulator is a module that provides simulator output by displaying visual representations of resources performing activities, the encapsulated simulation information includes I/O combinations correlated with
5 specific visual representations in a table and the step of gleaning includes accessing the table and retrieving the correlated combination/representation information.

13. The method of claim 12 wherein the controller also accepts feedback signals, the encapsulated simulation information further includes I/O feedback combinations correlated with specific simulation events in a feedback table, the step of gleaning includes accessing the feedback table and retrieving the correlated feedback combination/simulation
5 event information and, wherein, the simulator also provides output by providing feedback signals to the controller as a function of the gleaned information.

14. The method of claim 10 wherein the gleaned information includes a first simulation information set for the at least one identified CA and the method further includes the step of, for each of at least a subset of the CAs, encapsulating a second simulation information set in a data template and, wherein the step of using the gleaned information

5 includes the step of combining the first and second simulation information sets for each identified CA to generate a separate data structure for each identified CA.

15. The method of claim 14 wherein resource operation during activities is dependent on resource environment and each second simulation information set models a resource environment.

16. The method of claim 14 wherein resource operation during activities is dependent on resource characteristics and each second simulation information set models resource characteristics.

17. The method of claim 14 further including the step of, prior to compiling, sequencing requested activities and, wherein, resource operation during activities is dependent on prior activities and each second simulation information set includes information indicating prior activities and modeling the effects of prior activities on resource operation.

18. The method of claim 12 wherein the visual representations are motion pictures.

19. The method of claim 1 wherein the controller accepts feedback signals and, wherein, the simulation information is useable to generate simulation feedback signals indicating simulation events.

20. The method of claim 1 wherein the simulation information is useable to generate visual representations of resources cycling through activities.

21. The method of claim 20 wherein the controller accepts feedback signals and, wherein, the simulation information is also useable to generate simulation feedback signals indicating simulation events.

22. The method of claim 1 wherein the controller performs the code to generate output signals which, when provided to the at least one resource, cause the resource to cycle through requested activities and, wherein, the simulator information enables the simulator to receive the controller output signals and generate simulation output as a function thereof.

23. A control assembly (CA) set for generating code and simulation information for use by a controller and a simulator, respectively, wherein, the controller runs the code to generate output signals for controlling at least one resource, the CA set comprising:

at least one CA corresponding to at least one resource type, each CA

5 including:

a specification compilable to generate code for the corresponding resource type; and

a specification useable to generate simulation information for the corresponding resource type.

24. The CA set of claim 23 wherein, for at least a sub-set of the CAs in the CA set, the specification compilable to generate code and the specification useable to generate simulation information are the same specification.

25. The CA set of claim 23 wherein, for at least a sub-set of the CAs in the CA set, the specification compilable to generate code and the specification useable to generate simulation information are separate logic and simulation specifications, respectively.

26. The CA set of claim 25 also for use with an editor and wherein at least a subset of the logic specifications include logic characteristics that may be parameterized using the editor and wherein at least a subset of the CAs further include a recording means for recording parameterization.

27. The CA set of claim 26 wherein the recording means includes at least one flag box.

28. The CA set of claim 25 wherein the controller is a programmable logic controller which generates I/O combination output signals, the simulator is a module which generates visual representations of resources performing activities and each simulation specification correlates visual representations with I/O output combinations.

29. The CA set of claim 28 wherein the controller also accepts feedback signals and each simulation specification further includes I/O feedback combinations correlated with specific simulation events in a feedback table.

30. The CA set of claim 28 wherein the visual representations are motion pictures.

31. The method of claim 23 wherein the controller accepts feedback signals and, wherein, the simulation information is useable by the simulator to generate simulation feedback signals indicating simulation events.

32. The method of claim 23 wherein the simulation information is useable by the simulator to generate visual representations of resources cycling through activities.

33. The method of claim 32 wherein the controller accepts feedback signals and, wherein, the simulation information is also useable by the simulator to generate simulation feedback signals indicating simulation events.

34. The method of claim 23 wherein the controller performs the code to generate output signals which, when provided to the at least one resource, cause the resource to cycle through requested activities and, wherein, the simulation information enables the simulator to receive the controller output signals and to generate simulation output as a function thereof.

35. An apparatus to be used with a system including a simulator and a controller, the apparatus for generating code and simulation information for use by the controller and the simulator, respectively, the apparatus comprising:

- a database including at least one control assembly (CA) for at least one resource type, the at least one CA encapsulating logic information corresponding to the at least one resource type;
- an editor for identifying at least one instance of at least one CA corresponding to at least one resource,
- a processor running a program to perform the steps of:
 - 10 using the at least one identified CA to generate code for the corresponding at least one resource; and
 - using the at least one identified CA instance to generate simulation information for the corresponding at least one resource.

36. The apparatus of claim 35 wherein the processor executes the program to further perform the step of providing the code and the simulation information to the controller and the simulator, respectively.

37. The apparatus of claim 35 wherein the step of using the at least one identified CA instance to generate code includes compiling the at least one identified CA instance logic to generate the code.

38. The apparatus of claim 35 wherein the step of using the at least one identified CA instance to generate simulation information includes gleaned the information from the at least one identified CA and using the gleaned information to generate the simulation information.

39. The apparatus of claim 38 wherein at least one of the CAs also encapsulates simulation information for a corresponding at least one resource and wherein the processor gleans by retrieving the simulation information.

40. The apparatus of claim 39 wherein the controller is a programmable logic controller that provides I/O combination output signals, the simulator is a module that

displays visual representations of resources cycling through activities, at least a subset of the encapsulated simulation information includes I/O combinations correlated with specific

5 visual representations in a table and wherein the processor gleans by accessing the table and retrieving the correlated combination/representation information.

41. The apparatus of claim 40 wherein the controller also accepts feedback signals, at least a subset of the encapsulated simulation information further includes I/O feedback combinations correlated with specific simulation events in a feedback table and the processor gleans by accessing the feedback table and retrieving the correlated feedback

5 combination/simulation event information.

42. The apparatus of claim 39 wherein the gleaned information includes a first simulation information set and at least a second simulation information set is accessible to the processor and the processor performs the step of using the gleaned information by combining the first and second simulation information sets for each instantiated CA to generate a

5 separate data structure for each instantiated CA.

43. The apparatus of claim 35 wherein the controller accepts feedback signals and, wherein, the simulation information is useable by the simulator to generate simulation feedback signals indicating simulation events.

44. The apparatus of claim 35 wherein the simulation information is useable by the simulator to generate visual representations of resources cycling through activities.

45. The apparatus of claim 44 wherein the controller accepts feedback signals and, wherein, the simulation information is also useable by the simulator to generate simulation feedback signals indicating simulation events.

46. The apparatus of claim 35 wherein the controller performs the code to generate output signals which, when provided to at least one resource, cause the at least one resource to cycle through requested activities and, wherein, the simulation information enables the simulator to receive the controller output signals and generate simulation output

5 as a function thereof.

47. A control assembly (CA) set for generating code and simulation information for use by a controller and a simulator, respectively, wherein, the controller runs the code to generate output signals for controlling at least one resource, the CA set comprising:

at least one CA corresponding to at least one resource type, each CA

5 including:

material containing logic to facilitate the generation of code for the corresponding resource type; and

simulation material useable to generate simulation information for the corresponding resource type.

48. The CA set of claim 47 wherein, for at least a sub-set of the CAs in the CA set, the material containing logic to generate code and the simulation material useable to generate simulation information are the same material.

49. The CA set of claim 47 wherein, for at least a sub-set of the CAs in the CA set, the material containing logic to generate code and the simulation material useable to generate simulation information are separate material.

50. The CA set of claim 49 also for use with an editor and wherein at least a subset of the material containing logic includes logic characteristics that may be parameterized using the editor and wherein at least a subset of the CAs further include a recording means for recording parameterization.

51. The CA set of claim 49 wherein the controller is a programmable logic controller which generates I/O combination output signals, the simulator is a module which generates visual representations of resources performing activities and the simulation material correlates visual representations with I/O output combinations.

52. The CA set of claim 51 wherein the controller also accepts feedback signals and each simulation material further includes I/O feedback combinations correlated with specific simulation events in a feedback table.

53. The method of claim 47 wherein the controller accepts feedback signals and, wherein, the simulation information is useable by the simulator to generate simulation feedback signals indicating simulation events.

54. The method of claim 47 wherein the simulation information is useable by the simulator to generate visual representations of resources cycling through activities.

55. The method of claim 54 wherein the controller accepts feedback signals and, wherein, the simulation information is also useable by the simulator to generate simulation feedback signals indicating simulation events.